Agronomic Crops Team On-Farm Research Projects 1998

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Ohio Agricultural Research and Development Center
In Partnership With Ohio State University Extension

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Agronomic Crops Team On-Farm Research Projects 1998

Edited By

Phil E. Rzewnicki
On-Farm Research Coordinator

The Ohio State University
Ohio Agricultural Research and Development Center
Ohio State University Extension

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Contents

Editor's Introduction

This booklet contains the on-farm agronomic research results of Ohio State University Extension agents. Results are primarily from experiments conducted during 1998. All research trials in the report used at least three replications of the treatments compared. Many of the results reported are based on a single year of data. For the producers who collaborated in these trials and for those who read these results, one year of information should not be the basis for making major production changes. This information is published to stimulate discussion and to encourage further testing on individual farms. We hope that the publishing of these applied research reports will enhance the Agronomic Crops Team's efforts in meeting the needs of Ohio farmers and the state's agricultural industry. We would also like to express our appreciation to all the Ohio producers who participated in these trials.

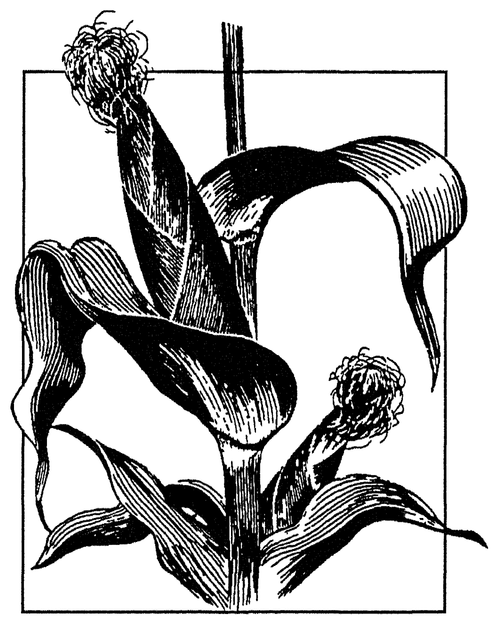
Editor

Phil E. Rzewnicki, On-Farm Research Coordinator

Review Committee

Ed Lentz, Northwest District Agronomy Specialist
Jeff Stachler, Extension Associate, Weed Science
Alan Sundermeier, Extension Agriculture/Natural Resources Agent

Corn



Ashtabula County Short-Season Corn Variety Test Plots

David Marrison, Extension Agriculture/Natural Resources Agent
Brian Forman, Lester Marrison, Keith Palmer, and Stan Ruck, Ashtabula County Producers
Phil Rzewnicki, On-Farm Research Coordinator

Objective

To provide a source of objective information on the relative performance of short-season corn hybrids currently available to Ashtabula County farmers.

Cooperator:	Keith Palmer
Nearest Town:	Andover
Major Soil Type:	Platea silt loam
Planting Population:	30,136/acre average
Plant Pop @ Harvest:	29,048/acre average
Previous Crop:	Wheat
Planting Date:	April 25, 1998
Harvest Date:	October 12, 1998
Plot Yield:	125.68 bu/acre
Plot Moisture:	18.1%

Cooperator:	Brian Forman
Nearest Town:	Geneva
Major Soil Type:	Sheffield silt loam
Planting Population:	26,800/acre average
Plant Pop @ Harvest:	17,464/acre average
Previous Crop:	Oats
Planting Date:	May 18, 1998
Harvest Date:	Oct. 27, 1998
Plot Yield:	109.87 bu/acre
Plot Moisture:	22.1%

Cooperator:	Lester Marrison
Nearest Town:	Jefferson
Major Soil Type:	Sheffield silt loam
Planting Population:	28,000/acre average
Plant Pop @ Harvest:	23,094/acre average
Previous Crop:	Grass/Legume Hay
Planting Date:	May 29, 1998
Harvest Date:	October 31, 1998
Plot Yield:	151.84 bu/acre
Plot Moisture:	23.6%

Cooperator:	Stan Ruck
Nearest Town:	Geneva
Major Soil Type:	Platea silt loam
Planting Population:	30,000/acre average
Plant Pop @ Harvest:	22,125/acre average
Previous Crop:	Soybeans
Planting Date:	June 4, 1998
Harvest Date:	Nov. 12, 1998
Plot Yield:	97.87 bu/acre
Plot Moisture:	24.7%

Methods

This research project was designed to study the performance of short-season corn hybrids using four farms within the county as replicates. Hybrids submitted for evaluation were 80–90 day hybrids, and the specific characteristics that were noted were: yield, harvest population, grain moisture at harvest, test weight, and gross return per bushel after corrections were made for drying costs and low test weights. A check variety with a maturity of 102 days (Countrymark 447) was used at each location.

Hybrids were randomly planted in field-length strips at each of the four farm locations. Hybrids were planted with a commercial-type planter. Fertilizer, herbicides, and insecticides were applied according to recommended cultural practices for obtaining optimum grain yields. If space permitted, each host farm was permitted to put additional varieties in its plot.

Results

Hybrid Performance Across Farm Locations

Hybrid (Maturity)	Yield (bu/ac) @15.5% moisture	Population plants/ac	Test Weight lbs/bu	Moisture %	Gross Return* $/acre
Novartis 3030Bt (95)	131.48 a	22,729	56	22.2	271.64
Pioneer 37M81 (97)	131.32 a	23,625	54	22.3	271.04
Novartis 2555Bt (90)	127.71 ab	26,245	59	19.7	270.23
Countrymark 447 (102)	124.82 abc	22,042	53	27.0	244.65
Countrymark 1660 (85)	123.29 abc	22,208	55	20.4	259.16
Pioneer 3905 (87)	118.48 bc	23,583	57	19.2	251.89
Novartis 4242Bt (100)	116.97 c	24,906	55	21.6	243.06
Novartis N15-B4(80)	102.50 d	23,409	57	18.9	218.53
Countrymark 1682 (88)	102.44 d	23,000	56	18.9	218.40

F = 8.06 Yields followed by same letter are not significantly different at $P = 0.05$.

CV(farm x variety) = 6.8% Analysis of variance used farm by variety interaction as estimate of experimental error.

Farm by variety interaction (F = 1.37) was not significant at $P = 0.05$ indicating that relative performance of all hybrids was not affected by farm location.

Population means were not significantly different among hybrids at $P = 0.05$ (F = 1.41, CV = 10.5%).

* Gross Return: $2.20 per bushel less discounts of 2 cents per point of moisture over 15.5% and 1 (53 lb), 3 (52 lb) cents for test weight under 54 lbs.

Summary and Notes

All nine corn hybrids in this experiment yielded higher than the 10-year county average of 98.88 bushels per acre, and seven yielded better than the five-year average of 111.08 bushels per acre. Given the relatively low number of growing-degree units available to Ashtabula County farmers, the use of short-season corn hybrids could potentially increase gross returns. The results of this analysis indicate that five of the hybrids returned higher gross returns than the long-season check variety (Countrymark 447). In addition, the shorter-season corn varieties had higher test weights and in a general field situation would be able to be harvested earlier in the fall when weather conditions are more favorable.

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Narrow-Row Corn Evaluation

Steve Ruhl, Extension Agriculture and Natural Resources Agent
Tom Weiler, Morrow County Producer
Ed Lentz, Extension Agronomy Specialist

Objective

Narrow-row corn may increase yields due to spreading the plants out to take better advantage of sunlight, moisture, and soil fertility. The objective of this study was to examine yield differences between 15- and 30-inch rows.

Nearest Town:	Chesterville
Drainage:	Systematic
Tillage:	Fall chisel, field cultivation
Previous Crop:	Soybeans
Soil Test:	pH 7.0
	P 23 ppm
	K 154 ppm
Fertilizer:	Pre-plant - 180 # NH3 Nitrogen, 200# 0-0-60, 12 gallon of 10-34-0
Variety:	Pioneer 33G26
Planting Date:	May 6
Harvest Date:	October 15

Herbicide Program:	
PRE:	Bicep II - 3 qt./acre
POST (6/18):	Accent - 2/3 oz./acre
	MSO - 1 gal./100 gallon spray
POST (6/25):	Banvel - 4 oz./acre
	Spirit - 1 oz./acre
	Crop Oil - 1 qt./acre
	28% N - 1/2 gal./acre
Herbicide Costs (excluding $4/acre spray costs):	
PRE:	$28.50/acre
POST (6/18):	$25.50/acre
POST (6/25):	$16.84/acre

Methods

The corn was planted with a six-row Kinze planter equipped for 15-inch rows. Treatments were replicated four times in a complete block design. Strip plots were planted in alternating 12-row plots containing 15- and 30-inch rows; therefore, treatments were not randomized within blocks. Individual strip plots were 30 feet wide and 453 feet long.

Row Width	Planting Population (#/acre)	Harvest Population (#/acre)	Harvest Moisture (%)	Yield (bu/acre)
15-inch	36,200	30,500 a	20.7 a	154.3 a
30-inch	36,000	29,750 a	20.7 a	165.5 b

Treatment means followed by the same letter are not significantly different from each other at $P = 0.05$. LSD for yield equals 7.4 bu/acre. CV = 2.1%

Summary and Notes

Pioneer 33G26 yielded significantly less in 15-inch row widths than in conventional width spacing. The field used for this study has an organic matter of approximately 12 percent. The weed pressure is severe especially for giant foxtail and giant ragweed. We sprayed three times and both post treatments (applied late) injured the corn. The brace roots were injured with the Banvel/Spirit combination. Accent injury was evident in the corn ears. If we conduct a similar plot next year, we will plant around 32,000 seeds in the 30-inch rows and 42,000 to 45,000 in the 15-inch rows. We will also try to be more timely with herbicide applications.

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Balance Herbicide on Corn

Steve Ruhl, Extension Agriculture and Natural Resources Agent
Tom Weiler, Morrow County Producer
Ed Lentz, Extension Agronomy Specialist

Objective

To evaluate the effectiveness of combinations of existing herbicides with a new preemergence herbicide called Balance.

Nearest Town:	Chesterville
Major Soil Type:	Millgrove
Drainage:	Systematic
Previous Crop:	Soybeans
Tillage:	Fall chisel, field cultivate
Variety:	Golden Harvest 2515
Planting Date:	May 6, 1998
Planting Population:	27,600/A
Soil Test:	pH 7.0
	P 23 ppm
	K 154 ppm
Fertilizer Applied:	180 lb NH_3^+/A
Herbicides:	Various - Applied May 12
Plant Population @Harvest:	25,200/A
Harvest Date:	October 15

Methods

Eight different treatments were replicated four times in a random block design. Individual plot size was 10' wide x 40' long. An untreated control was left to determine the weed pressure at the site. The treatments were rated on their effectiveness in controlling annual grasses, lambsquarters, giant ragweed, and velvetleaf 86 days after application (August 6). The weed pressure was light to moderate at this site.

Pre-Emerge Treatment	Rate/A	Weed Control Rating (%) Annual Grass	Lambs-quarter	Giant Ragweed	Velvetleaf	Herbicide Cost ($)	Total Cost ($)*
Balance	2 oz	90.0 c	100 a	97.8 b	99	16.00	20.00
Balance Dual II	2 oz 1 pt	90.3 c	100 a	97.8 b	100	16.00 9.38	29.38
Balance Bicep II	2 oz 1.2 qt	91.0 c	100 a	100 a	100	16.00 11.40	31.40
Balance Harness Xtra	2 oz 1.25 qt	99.3 a	100 a	100 a	100	16.00 11.88	31.88
Balance Atrazine	2 oz 1.5 lb	90.3 c	100 a	100 a	100	16.00 4.97	24.97
Bicep II	2.7 qt	88.3 c	92.0 b	100 a	100	25.65	29.65
Balance Bicep II Simazine	2 oz 1.2 qt 0.75 lb	91.0 c	100 a	100 a	100	16.00 11.40 2.84	34.24
Balance Dual II Atrazine	2 oz 1 pt 1.5 lb	94.8 b	100 a	100 a	100	16.00 9.38 4.97	34.35
LSD (0.05%)		3.7	1.1	1.1	NS		
CV		2.8%	1.1%	0.8%	0.7%		

* Application cost $4.00/A included in each treatment. Prices used were in-season retail prices.

Weed control ratings equal percent of weeds controlled relative to untreated check. Average of four replications.

Treatment means followed by the same letter are not significantly different from each other.

Summary and Notes

In the spring Balance was an experimental preemergence corn herbicide with activity on annual grasses and broadleaf weeds. During September 1998 Balance received a full label for use by the EPA. Balance looks to be a good herbicide choice for producers. According to this trial, grass control was significantly enhanced when a half rate of Harness Xtra was added to Balance. Giant ragweed control was also improved by adding other preemergence herbicides with the exception of Dual II. Because of the light to moderate weed pressure, the weed control results were all acceptable. When Balance is used in addition to reduced rates of traditional corn herbicides, it should provide excellent control over a wide variety of weed pressures, except for giant ragweed, morningglory, or common cocklebur.

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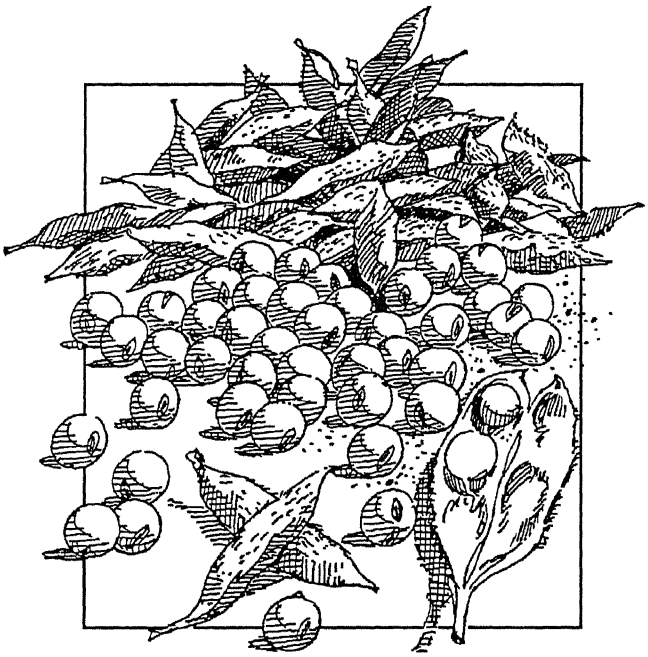
Soybeans



The Effect of Crop Rotation On Soybean Cyst Nematode Management

Alan Sundermeier, Extension Agriculture and Natural Resources Agent
Beck Brothers, Henry County Producers

Objective

Study the changes in soybean cyst nematode levels during crop rotation.

Nearest Town:	Napoleon
Soil type:	Millgrove loam
Tillage:	No-till
Crops:	1995 - soybean; 1996 - corn; 1997 - corn; 1998 - resistant soybeans

Methods

In 1995, four soybean-cyst-nematode-resistant varieties (Asgrow 3134, Asgrow 3431, AgriPro 3460, Callahan 3377) and two susceptible varieties (Resnick, Asgrow 3237) were replicated three times and randomly planted into a nematode-infested field. Individual plots were 15' by 500'. Soil samples for cyst nematode egg counts were randomly collected at four-inch depths in each plot. Samples were taken in June and September each year. Corn was planted in the entire study area in 1996 and 1997 and cyst nematode resistant soybeans in 1998.

Results

Average Number of Cyst Nematode Eggs/200 cc Soil

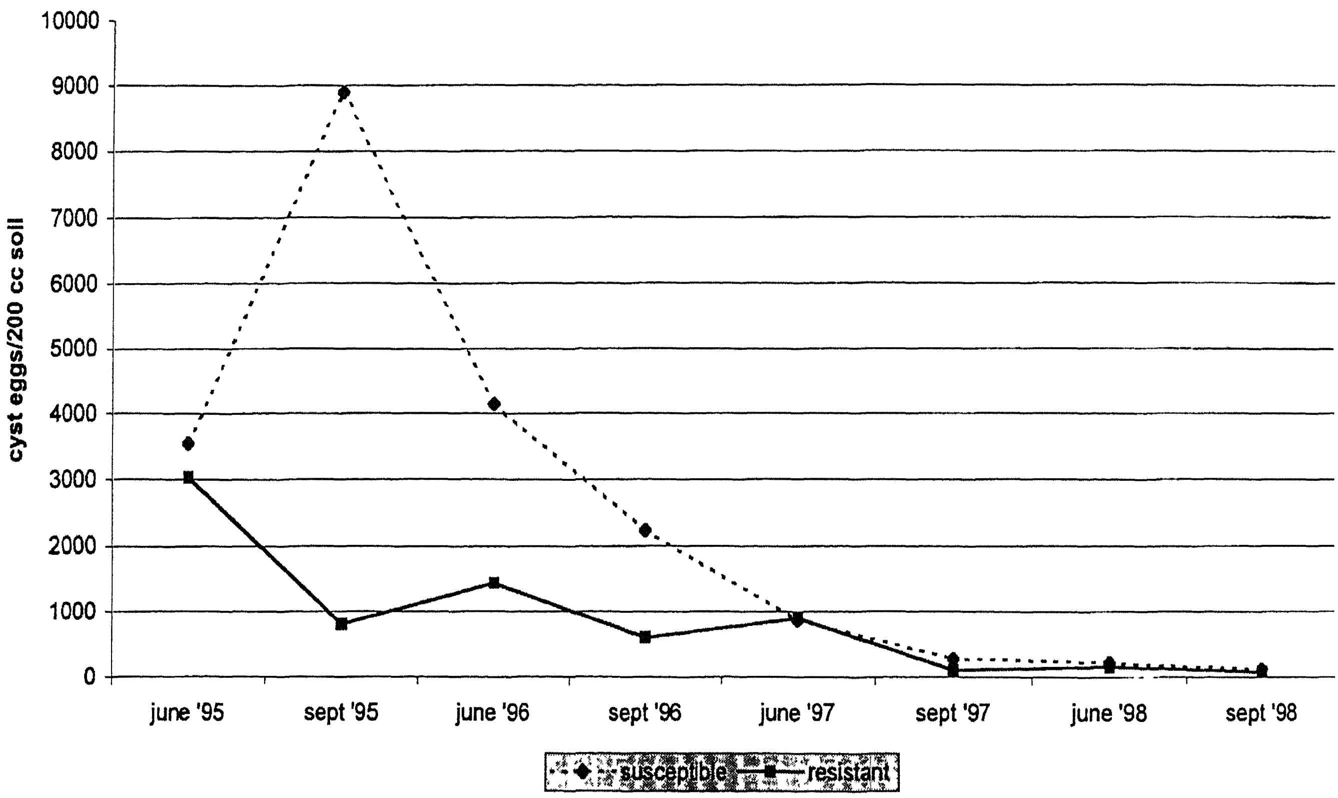
	Soybean		Corn		Corn		Resistant Soybean	
	June 95	Sept 95	June 96	Sept 96	June 97	Sept 97	June 98	Sept 98
Asgrow 3134 (R)	2880	213	1427	373	1120	120	0	67
Resnick (S)	3813	9947	5093	2840	907	133	67	147
AgriPro 3460 (R)	3827	667	1467	1053	773	120	200	93
Asgrow 3431 (R)	2840	1840	1760	680	867	93	373	107
Callahan 3377 (R)	2560	533	1067	307	800	107	53	40
Asgrow 3237 (S)	3280	7840	3200	1613	813	427	360	93
Average Susceptible	3547	8893	4147	2227	860	280	213	120
Average Resistant	3027	813	1430	603	890	110	157	77
LSD ($P = 0.05$)	1521	2161	1568	1065	374	145	277	57
Significant Difference	No	Yes	Yes	Yes	No	Yes	No	No

Summary and Notes

One year of corn following susceptible soybeans did not lower cyst counts (2,227 eggs/200cc soil) to safe levels compared to one year of corn following resistant soybeans, which reduced cyst levels to 603 eggs/200 cc soil. Two years of corn were needed to lower soybean-cyst-nematode egg counts (below 500 eggs/200cc soil) to safe levels. In 1998 resistant soybeans did not allow cyst counts to increase.

This study confirms soybean-cyst-nematode control recommendations. After nematode infection is confirmed when planting susceptible SCN soybean varieties, plant two years of corn followed by one year of SCN resistant soybeans. Then, with counts below 500 eggs/200 cc soil, farmers may again use susceptible SCN soybeans in rotation.

Soybean Cyst Nematode Rotation Plot



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Early Planting Dates for No-Till Soybeans

Steve Ruhl, Extension Agriculture and Natural Resources Agent
Tom Weiler, Morrow County Producer
Ed Lentz, Extension Agronomy Specialist

Objective

Planting soybeans early may help to spread out planting time workload for producers. The objective of this study was to determine the effect of early planting on yields of no-till soybeans.

Nearest Town:	Chesterville	Soil Test:	pH 6.7
Major Soil Type:	Chili		P 30 ppm
Drainage:	Random tile, well drained		K 123 ppm
Tillage:	No-Till	Fertilizer Applied:	200 lbs of 0-0-60 per acre
Previous Crop:	Corn	Herbicide Program:	3 oz./Acre. Canopy - Preplant
Variety:	Callahan 7391 RR with Supercoat Seed Treatment		1 qt./Acre. Roundup - Post
Plant Population:	212,000	Planting Dates:	3/30, 4/13, 4/24, and 5/13
		Harvest Date:	October 1

Methods

Treatments were three early planting dates and a normal mid-May planting date. A single soybean variety with a relative maturity of 4.1 was planted with a 750 JD No-Till Drill. There were three replications in a complete block design. Treatments were sequentially planted to an adjacent strip within each block and therefore were not randomized. Strip plot length averaged 959 feet with widths of 20 feet.

Soil conditions for planting were excellent on March 30 and April 13, fair on April 24, and good on May 13. Excellent = soil crumbles behind drill and no tractor cleat marks form; good = soil crumbles behind drill with some tractor cleat marks in wetter areas of field; fair = soil crumbles some behind drill, tractor cleat marks in many areas of field, and some disk furrows remain open; and poor = planter furrows do not close, seed is exposed, and cleat marks are evident all over field.

Results

Planting Date	% Moisture	Yield (bu/acre)
March 30	11.4 A	51.94 A
April 13	11.3 A	48.60 B
April 24	11.2 A	47.90 B
May 13	11.8 B	49.19 B

Treatment means followed by the same letter are not significantly different at $P = 0.05$
Moisture level LSD = 0.36. Yield LSD = 2.39 bu/ac
CV (moisture) = 1.6% CV (yield) = 2.4%

Summary and Notes

The yield of the earliest planted soybeans was significantly higher than the other three planting dates. Harvest moisture was significantly higher for the latest planting. All plantings had good stands of soybeans. The beans were clean and tall. The early soybeans even survived a late frost of 26°F. From the results of this trial, it appears early planting can be successful in achieving good yields.

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Acknowledgement

This project was funded in part from funds made available from the Ohio Soybean Council.

Soybean Fungicide and Inoculant Evaluation

Bruce Clevenger, Extension Agriculture and Natural Resources Agent
Ed Lentz, Extension Agronomy Specialist
Phil Rzewnicki, On-Farm Research Coordinator

Objective

To evaluate the effectiveness of Apron/Rival fungicide seed treatment and three soybean inoculants.

Cooperator:	Defiance Ag Research Association		
County of Site:	Defiance	Herbicides:	**Pre-plant** (5/14/98)
Nearest Town:	Ney		3.8 oz Canopy XL
Major Soil Type:	Roselm Silty Clay		4.0 oz Lexone DF
	Paulding Clay		0.75 pt 2,4-D LV4
Drainage:	Surface		AMS, COC, Citric Acid
Tillage:	No-till		**Postemergence** (7/3/98)
Previous Crop:	Corn		5 oz Select
Variety:	DeKalb 289		28% N, COC
Planting Date:	5/20/98	Apron XL Rate:	0.25 oz/bu
Planting Rate:	182,400 seeds/acre	Rival Rate:	2.4 oz/bu
Row Space:	7.5" Drilled	Hi-Stick Rate:	1.75 oz/bu
		Hi-Stick NT Rate:	1.75 oz/bu
		RhizoStick Rate:	0.2 lb/bu

Methods

A three-year study (1998–2000) was initiated to compare one fungicide treatment against no fungicide treatment for control of early-season seedling blights such as Phytophthora and Rhizoctonia. The fungicide study included a comparison of three soybean inoculants. Experimental design was a split plot experiment. Fungicide treatments were randomly applied to whole plots with four replications, and inoculant treatments were randomly applied to the split plots resulting in eight replications of inoculum levels. Split plots were 30 ft. by 660 ft. in size.

All fungicide treatments were commercially applied at a local co-op. All inoculant treatments were applied in the field in the drill seed box just prior to planting and after all no-inoculant treatments were drilled. The seed box was vacuumed following each treatment to eliminate residual inoculant between treatments.

Plots were harvested on October 1, 1998, with a JD 9600 combine with an Ag Leader 3000 yield monitor equipped with a Global Positioning System. Harvest data were collected from the center 25 feet of each subplot. The yield monitor was calibrated, and scale weights were used to verify accuracy.

Results

1998 Soybean Fungicide Yield Data

Treatment	Yield bu/A	Treatment Cost $
Apron/Rival Fungicide	62.1	4.05
No Fungicide	61.9	

F = 0.01 No significant differences between treatment means at P = 0.05 CV = 4.3%

1998 Soybean Inoculant Yield Data

Treatment	Yield bu/A	Treatment Cost $
HiStick NT	62.9	4.32
HiStick	62.2	2.65
RhizoStick	60.3	2.13
No Inoculant	62.4	

F value = 0.52 No significant differences among treatment means at P = 0.05 CV = 7.1%

Analysis of variance was conducted by SAS PROC MIXED which detected no significant differences between the fungicide treatment levels and among the inoculant treatments at a probability level of $P = 0.05$. There were also no significant interaction effects on yield due to fungicide and inoculant combinations.

Summary and Notes

The spring of 1998 was relatively dry following the planting date in this study. Therefore, early season blight pressure was not heavy. Yields did not significantly respond to the protection of the fungicide. The 1998 growing season came with timely rainfall during both vegetative and reproductive stages of development. Yields did not significantly respond to the additional soybean inoculants. These results are the first of three years of data that will be collected.

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Soybean Inoculant Trial

David Jones, Extension Agriculture and Natural Resources Agent
Loren Creeger, Allen County Producer
Ed Lentz, Extension Agronomy Specialist
Phil Rzewnicki, On-Farm Research Coordinator

Objective

The objective of this trial was to examine the performance of a new soybean inoculum product on a farm in Allen County.

Nearest Town:	Lima	Tillage:	No-Till
Variety:	DeKalb 370RR	Previous Crop:	Corn
Planting Date:	5/23/98	Herbicide:	Two post applications 1 pt. Roundup 30 days apart
Seeding Rate:	170,000	Harvest Date:	10/14/98

Methods

A new pre-mixed, humus-based inoculant containing a USDA-patented strain of *Rhizobium* with sticking agent was compared to not using any inoculant. Producer used four replications with each strip plot being 40' by 1140' in size. Harvest data were taken from each 1.05-acre strip. The experiment design was complete block without randomization.

Results

No Inoculum Yield	42.0 bu/acre
Inoculum Yield	42.2 bu/acre

$F = 0.06$ No significant difference between treatment means at $P = 0.05$ $CV = 2.7\%$

Summary and Notes

The inoculum treatment did not significantly increase yields. Experimental error was well controlled as indicated by the low coefficient of variation.

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Acknowledgement

This project was funded in part from funds made available from the Ohio Soybean Council.

Effect of New Soybean Inoculants on Yields

Steve Ruhl, Extension Agriculture and Natural Resources Agent
Tom Weiler, Morrow County Producer
Ed Lentz, District Agronomy Specialist
Phil Rzewnicki, On-Farm Research Coordinator

Objective

Newly available inoculants may be able to improve nitrogen production by rhizobia bacteria. This study examined the effect of these new soybean inoculants on yields.

Nearest Town:	Chesterville
Major Soil Type:	Chili
Drainage:	Random tile
Tillage:	No-till
Previous Crop:	Corn
Soil Test:	pH 6.7
	P 30 ppm
	K 123 ppm

Fertilizer Applied:	200 lbs of 0-0-60 per acre
Herbicides:	3 oz./acre Canopy - pre-plant
	1 qt. Roundup Ultra + 3 # AMS/Acre - Post
Plant Population:	205,400
Plant Population @ Harvest:	171,000
Variety:	Stine 3264RR
Planting Date:	April 25
Harvest Date:	October 1

Methods

The two products studied were Cell-Tech 2000 and a powdered peat containing a USDA patented strain of *Bradyrhizobium japonicum*. A third treatment was the absence of an inoculum application. Treatments were replicated three times in a randomized, complete block design. Individual strip plots were 39 feet wide and averaged 1,698 feet in length.

Results

Treatments	% Moisture	Yield (bu/acre)
Cell-Tech 2000	11.6	40.1
No Inoculum	11.7	39.8
USDA (Powdered Peat)	11.6	38.7
F-Test	0.55	0.66
Significance ($P = 0.05$)	NS	NS
CV	1.2%	4.0%

Summary and Notes

Contrary to many studies completed across the Midwest where these new inoculants have shown an average of 4 to 6 percent increase in yield, we did not find a significant increase. Rainfall was very short at the site in August/September with a total rainfall of only 2.4 inches for the two-month period. Nitrogen availability may not have been the determining factor with the limited moisture situation.

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Acknowledgement

This project was funded in part from funds made available from the Ohio Soybean Council.

Soybean Inoculant Trials

Chris Bruynis, Extension Agriculture and Natural Resources Agent
Dean Koehler, Rod Phillips, and Gary Walter, Wyandot County Producers
Phil Rzewnicki, On-Farm Research Coordinator
Ed Lentz, Extension Agronomy Specialist

Objective

The objective of this trial was to compare the performance of new soybean inoculum products on three farms in Wyandot County.

Sites:	Dean Koehler, Nevada	Rod Phillips, Carey	Gary Walter, Upper Sandusky
Variety:	322 STS	DeKalb 267	Callahan 7383
Planting Date:	5/21/98	5/22/98	5/23/98
Planting Rate:	235,000	225,000	230,000
Tillage:	No-Till	No-Till	No-Till
Soil Type:	Blount A	Lykins A	Blount A
Previous Crop:	Corn	Corn	Corn

Method

A new pre-mixed, humus-based inoculant containing a USDA-patented strain of *Rhizobium* with sticking agent was compared to not using any inoculant on three producer fields. Dean Koehler used 30' by 900' long strip plots. Rod Phillips and Gary Walter both used 45' by 1/2 mile long strips. The experiment design was a randomized, complete block with six replications at each site. Harvested sections of each strip plot were as follows: Koehler farm, 0.82 acre; Phillips farm, 0.30 acre; and Walter farm, 0.28 acre.

Results

	Koehler Farm	Phillips Farm	Walter Farm
No Inoculum Yield	54.0 bu/acre	65.4 bu/acre	54.0 bu/acre
Inoculum Yield	54.3 bu/acre	65.9 bu/acre	54.3 bu/acre
F test	0.24	0.67	2.39
Significance (P=0.05)	NS	NS	NS
CV	1.4%	3.0%	3.9%

Summary and Notes

On all three farms the inoculum treatment did not significantly increase yields. Experimental error was well controlled as indicated by low coefficients of variation.

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Acknowledgement

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Roundup Ready Soybean Yield Evaluation

Steve Ruhl, Extension Agriculture and Natural Resources Agent
Tom Weiler, Morrow County Producer
Ed Lentz, Extension Agronomy Specialist

Objective

To compare the yield performance of six Roundup Ready soybean varieties from five companies.

Nearest Town:	Chesterville	Harvest Date:	October 1
Major Soil Type:	Sleeth	Harvest Date:	October 1
Drainage:	Systematic	Herbicide Program:	1.5 qt. of Roundup Ultra at the V-3 stage
Tillage:	Fall chisel, field cultivate		
Previous Crop:	Corn	Planting Population:	200,000/acre
Soil Test:	pH 7.0	Plant Population @Harvest:	156,000/acre
	P 23 ppm	Planting Date:	May 12
	K 154 ppm	Harvest Date:	October 15

Methods

Six varieties of Roundup Ready soybeans having maturity ratings of 3.3 to 4.0 were planted. The varieties were replicated three times in a randomized complete block design. Harvested plot areas were 7' by 40' for each variety replicate.

Results

Variety (Maturity)	Harvest Moisture (%)	Yield @ 13% moisture (bu/A)
Pioneer 93B51 (3.5)	12.0	74.3 A
Countrymark RT357RR (3.9)	11.8	65.5 B
Pioneer 9333 (3.3)	12.0	61.4 B
Crows 34009 (3.4)	12.1	60.0 BC
Golden Harvest 1351RR (3.8)	11.6	58.7 BC
Callahan 7363RR (4.0)	11.5	54.3 C
LSD (P = 0.05)		7.51
CV		10.3%

Summary and Notes

Pioneer 93B51 yielded significantly higher than all the other varieties examined at this location in 1998. The plots were all free of weeds. Each variety grew tall, and the soybeans were all leaning at harvest time. The study indicates that all Roundup Ready soybeans are not equal performers. Producers need to be selective when choosing varieties.

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Roundup Ready Soybeans vs. Conventional Soybeans

Barry Ward, Extension Agriculture and Natural Resources Agent
Ed Lentz, Extension Agronomy Specialist

Objective

To determine yield and moisture differences in conventional soybean production systems vs. Roundup Ready soybean systems.

Cooperator:	Marion H.S. FFA	Herbicides:	POST - 1.25 pt Flexstar, 0.2 oz Firstrate, 8 oz Fusion COC 1% v/v, 28% N 2% v/v POST on RR soybeans - 1 qt/A Roundup Ultra
County of Site:	Marion		
Nearest Town:	Marion		
Major Soil Type:	Milford		
Planting Date:	6/2/98, No-till Drill 7" rows		

Methods

Two varieties of Roundup Ready soybeans were planted in a randomized complete block experiment with two varieties of conventional soybeans from the same seed company. Four replications were used of each variety in 25' x 175' side by side strips.

Results

	Yield (13.0% moisture) bu/A	**Harvest Moisture %**
Pioneer 9396RR	51.04	12.2
Pioneer 92B51RR	50.26	12.1
Pioneer 9395	49.30	12.0
Pioneer 9245	52.87	11.9
F-Test	1.18	0.76
Significance (P = 0.05)	NS	NS
CV	5.5%	2.8%

Summary and Notes

Differences were noted in the overall appearance of the bean plants after post applications of conventional herbicide program. Plant foliage of conventional soybeans was noticeably burnt by Roundup drifting from adjacent Roundup Ready plots. No significant differences were found in yields among the four varieties, and no differences were detected between the conventional soybeans and Roundup Ready soybeans.

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Effect of Roundup and Other Herbicides On Roundup Ready Soybean Yields

Steve Ruhl, Extension Agriculture and Natural Resources Agent
Tom Weiler, Morrow County Producer
Ed Lentz, Extension Agronomy Specialist

Objective

The adoption of Roundup Ready soybeans has been rapid. However, there are a few weeds that Roundup Ultra doesn't control satisfactorily and it has no residual effect. As a result, producers may want to use other herbicides with Roundup Ultra. This trial was conducted to examine the effect of applying other herbicides with Roundup Ultra on the yield of Roundup Ready soybeans.

Nearest Town:	Chesterville	Soil Test:	pH 7.0
Major Soil Type:	Chili		P 23 ppm
Drainage:	Systematic		K 154 ppm
Previous Crop:	Corn	Fertilizer Applied:	200 lbs of 0-0-60 per acre
Tillage:	Fall chisel & field cultivation	Plant Population:	200,000 seeds/acre
Variety:	Callahan 7391RR	Harvest Plant Population:	168,000 plants/acre
Planting Date:	May 12	Harvest Date:	October 1

Methods

The field chosen has tremendous giant ragweed, lambsquarter, and giant foxtail pressure. The field was chisel plowed and weeds worked out at planting time. The additional herbicides used were Cobra (5 oz./A), Canopy XL (3 oz./A), and Pursuit (1.44 oz./A). Canopy XL was applied preemergence. Pursuit and Cobra were applied post-emergent within an hour after an application of 1.5 quarts of Roundup Ultra and 3 pounds of AMS per acre at the V-3 stage of soybean growth. These treatments were compared to 1.5 quarts of Roundup Ultra sprayed alone at the V-3 stage.

Giant ragweed pressure was severe with 24- to 36-inch tall weeds at the time of the postemergence application. The treatments were replicated three times with individual treatment plots being 20 feet x 500 feet.

Results

Herbicide Treatment	Soybean Yield (bu/acre)	Total Herbicide Cost ($)
Cobra + Roundup + 3# AMS/A	62.99	27.33
Canopy XL fb Roundup + 3# AMS/A	61.60	30.71
Roundup + 3# AMS/A (V3 Stage)	60.06	21.75
Pursuit + Roundup + 3# AMS/A	58.99	46.33

F = 0.83 No significant differences among treatment means at $P = 0.05$ CV = 11.0%
Abbreviations: A = acre, AMS = ammonium sulfate, fb = followed by

Summary and Notes

Weed control was excellent for all treatments. According to the results of this trial, the addition of the other herbicides used did not significantly effect yields of the Roundup Ready soybeans.

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The Effect of Urea on Soybean Yield at R1.2

Steve Prochaska, Extension Agriculture and Natural Resources Agent

Objective

It has been theorized that soybeans would benefit from supplemental nitrogen applications during early reproductive growth states. The objective of this study was to examine soybean yield response to supplemental nitrogen applied during early reproductive stages.

Test Site:	Ohio State University Unger Farm	Soil Test:	pH 7.3 P 16 ppm K 88 ppm
County of Site:	Crawford		
Soil Type:	Pewamo	Fertilizer:	27-69-60 applied fall 1997 Urea spread @49.5 lbs actual N 7/6/98
Drainage:	Systematic		
Irrigation:	None		
Tillage:	Field cultivated twice in spring	Herbicide:	Roundup Ultra 1 qt
Previous Crop:	Pumpkins	Seeding Rate:	63 lbs/acre
Soybean Hybrid:	Pioneer 9333	Planting Date:	5/14/98
		Harvest Date:	9/25/98

Materials and Methods

Urea @ 107.5 lbs/acre was applied in 30' swaths (used only one boom) with Ag Chem air machine in three random strips across soybeans at growth stage R1.2. Rainfall occurred July 7, 1998, thus lessening nitrogen volatilization losses. The center 22 feet of the strip plots were harvested to measure treatment effect. Individual harvested plot size was 0.17 acre. Experiment design was completely randomized with three replications for each treatment.

Results

Treatment	**Yield (bu/acre)**
Urea	63.07
No Urea	65.93

$F = 2.06$ Not significant at $P = 0.05$ CV = 3.8%

Summary and Notes

Each bushel of soybeans contains from 3.0 to 3.5 pounds of nitrogen. Thus, a 60-bushel-per-acre yield of soybeans requires 180 to 210 pounds of nitrogen. Soybeans, being legumes, have a symbiotic relationship with *Rhizobium* bacteria. These bacteria have the ability to fix 200 pounds of nitrogen or more per acre. However, there are reproductive stages in the growth of soybeans where nitrogen deficiency may occur. In this study, there was no significant difference between treatments. These results are consistent with previous studies on this topic.

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Roundup Ready Soybean Variety Evaluation in a Modified Relay Intercropping System

Steve Prochaska, Extension Agriculture and Natural Resources Agent

Objectives

To evaluate the yields of two Roundup Ready soybean varieties in a Modified Relay Intercropping (MRI) system.

Test Site:	The Ohio State University Unger Farm	Fertilizer:	Applied fall 1997: 26-104-120 spring 103 lbs N applied 3/27/98
County:	Crawford	Herbicide:	1 qt Roundup Ultra applied 7/31/98
Major Soil Type:	Blount		
Drainage:	Non-Systematic	Interseeded:	Soybeans 6/8/98
Irrigation:	None	Seeding Rate:	75 lbs/acre
Soil Test:	pH 6.9	Varieties:	Asgrow AG2701 (2,750 seeds/lb)
	P 31 ppm		Pioneer 93B01 (3,200 seeds/lb)
	K 122 ppm		

Materials and Methods

Soybeans were planted into 10-inch row wheat with a Great Plains 1500 drill. Drill was on a three-point hitch of the tractor to plant soybeans. The same drill was used for both wheat and soybean planting. Twenty-inch tram lines were also established in the 15' wide plots. Weeds present included giant ragweed, volunteer wheat, giant foxtail, lambs quarter, Canada thistle, field bindweed. Experiment design was completely randomized with three replications.

Results

Variety	Yield (bu/acre)
Asgrow A2701	41.97
Pioneer 93B01	39.77

F = 1.13 Not significant at $P = 0.05$ CV = 6.2%

Summary and Notes

Roundup Ready soybeans performed very well in a Modified Relay Intercropping system in 1998. The two varieties tested were not significantly different from each other.

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Wheat

Wheat Seeding Rate Comparisons

Dennis Baker, Extension Agriculture and Natural Resources Agent

Objective

To determine whether wheat yields increase as seeding rates increase.

Cooperator:	Darke County Farm	Soil Test:	pH 7.3
Nearest Town:	Greenville		P 30 ppm
Major Soil Type:	Miami		K 148 ppm
Drainage:	Tile	Fertilizer:	100#/A 0-0-60
Tillage:	No-till		125 #/A 18-46-0
Previous Crop:	Soybeans		165#/A 46-0-0 topdress
Herbicides:	None	Planting Rate:	90#, 120#, 150# lbs/A
Hybrid:	Shurgrow 1550		(25, 33, 41 seeds/ ft. of row)

Methods

A replicated study using three replicates in a randomized complete block design was planned to determine whether increasing seeding rates of wheat will increase yields. Shurgrow 1550 was seeded on October 9, 1997, using a John Deere no-till drill at three target seeding rates. Each test strip was 30′ by 1,055′ in size. The wheat overwintered well and was topdressed on March 20.

Results

Treatment	Yield (Bu/A)
90# seeding rate	63.50
120# seeding rate	60.09
150# seeding rate	62.18

F = 1.41 No significant difference in yields among all treatments at $P = 0.05$, CV = 4.0%

Summary and Notes

There was no significant difference in yields among the different seeding rates. This is consistent with results of similar plots done on this farm the past 10 years. Thickness of straw is noticeably larger on lower seeding rates. Plants were counted in November in three-foot lengths of row in each of the three seeding rates and compared to number of heads produced in the spring. Lower seeding rates produce more tillers per plant than higher seeding rates.

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A Summary of White Wheat Research from 1995 to 1998

Steven Prochaska, Extension Agriculture and Natural Resources Agent

Objectives

To compare yields of red wheat varieties and white wheat varieties and to obtain agronomic information on white wheat production in Crawford County.

Location:	Ohio State University Unger Farm in Crawford County	Tillage:	No-till
		Previous Crop:	Soybeans
		Seeding Rate:	120 lbs/acre
Soil Type:	Blount		
Drainage:	Non-systematic		

Methods

A replicated study comparing red and white wheat varieties was implemented in the fall seasons of 1994 through 1997. Three red wheat varieties — Pioneer 2545, Pioneer 2510, Freedom — and three white wheat varieties — Augusta, Frankenmuth, and Chelsea — were selected for planting in 1994 based on previous milling data and yield performance. Varieties planted in 1995 suffered severe winter injury, and data were not taken. In 1996, one red wheat variety, Hopewell, and three white wheat varieties, Karena, Bavaria, Pioneer 2737W, were selected. Hopewell was again used in 1997 as well as Pioneer 2737W with the addition of Pioneer 25W33, a white wheat. Farmers are presently paid primarily for bushels, not quality, so it is important to evaluate white wheats with high-yielding red wheats.

Results

Wheat Yields by Year

White Wheat	Yield (bu/acre)	Red Wheat	Yield (bu/acre)
	1994–95 Growing Season*		
Frankenmuth	59	Freedom	63
Augusta	55	Pioneer 2510	63
Chelsea	45	Pioneer 2545	54
Average	53	Average	60
	1996–97 Growing Season		
Pioneer 2737W	81	Hopewell	74
Karena	71		
Bavaria	67		
Average	73	Average	74
	1997–98 Growing Season**		
Pioneer 25W33	96	Hopewell	97
Pioneer 2737W	84		
Average	90	Average	97

* Yields for 1994–95 represent average of 2 test plots
** Yields for 1997–98 from the Ohio Performance Test plots conducted in Crawford County

Across year averages for the three years of data, the overall mean of white wheat types is 72.0 bu/acre, and the mean for red wheat types is 77.0 bu/acre. The two means are not significantly different at $P = 0.05$ or $P = 0.10$ with $F = 6.41$ and a CV of 14.3% (based on year by wheat type interaction).

Summary and Notes

The yields of the varieties selected for these trials were not significantly different in terms of white wheat type versus red wheat types. Disease susceptibility, winter hardiness, and harvest dates were similar across types within each year.

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Evaluation of Red and White Wheat Varieties in a Modified Relay Intercropping System

Steve Prochaska, Extension Agriculture and Natural Resources Agent

Objectives

To evaluate disease incidence and agronomic performance of red and white wheat varieties in a Modified Relay Intercropping (MRI) System.

Test Site:	Ohio State University Unger Farm
County:	Crawford
Major Soil Type:	Blount
Drainage:	Non-Systematic
Irrigation:	None
Tillage:	No-tillage
Previous Crop:	Soybeans
Planting Date:	Wheat planted 10/10/97 @ 120 lbs/acre
Soil Test:	pH 6.9 P 31 ppm K 122 ppm
Fertilizer:	Applied fall 1997: 26-104-120 Spring 103 lbs N applied 3/27/98
Herbicide:	1 pt 2,4-D amine 4/13/98 at Feeke's 5 to 6 growth stage, 1 qt Roundup Ultra applied 7/31/98
Interseeded:	Soybeans 6/8/98
Seeding Rate:	75 lbs soybeans/acre

Materials and Methods

Wheat was planted in a 10-inch row spacing with a 20-inch tram line with a Great Plains 1500 drill. Soybeans were planted into the 10-inch row wheat with the same drill as used for wheat on 6/8/98. Wheat had completed flowering. Drill was on a 3-point hitch of the tractor for planting of soybeans into wheat. Experiment design was completely randomized with three replications of two white varieties (Pioneer P25W33 and P2737W) and two red varieties (Hopewell and X15).

Results

Variety	Yield (bu/acre)
P25W33	80.7
Hopewell	79.6
P2737W	72.0
X15	66.4

$F = 4.09$ Not significant at $P = 0.05$ CV = 7.8%

Summary and Notes

All wheat was heavily tillered in 1998. The white wheat, 25W33, was also slightly injured by 2,4-D application. Interseeding of soybeans damaged both white wheats due to the sprawling habit of the wheat. An estimated 10–20% loss of yield in white wheats occurred as a result of interseeding. Hopewell wheat was the least damaged by interseeding due to its non-spreading growth habit.

One of the issues associated with white wheat production is sprouting of the mature seeds in the head under damp environmental conditions. In 1998 conditions conducive to wheat sprouting (five inches of rain and 100% relative humidity for nearly five days) occurred with no accompanying sprouting of the white wheat.

Soybean yields were 42 bu/acre in the Hopewell wheat, 40 bu/acre in the X15 wheat, and 32 bu/acre in the two white wheats. This reduction in soybeans was due to poor final stand resulting from difficulty in interseeding into the sprawling white wheat.

In conclusion, the white wheats are competitive in yield and comparable in disease resistance to top red wheats. White wheat can be successfully grown in Crawford County with the same performance expectations as red wheat. However, a tendency towards sprawling growth for the white wheat varieties in this trial may limit their usefulness for interseeding soybeans.

Wheat Varieties — Disease and Agronomic Observations

Variety	Characteristics	Comments
Hopewell	Height — 38" Diseases — Light Stagnospora	Very uniform red wheat that has done well in Crawford County. Nice architecture for MRI.
X15	Height - 35" Diseases — Stagnospora, Rust, heavy Powdery Mildew	Aggressive early red wheat. Very susceptible to a number of diseases. If treated with a fungicide, may be a good wheat for MRI.
Pioneer 25W33	Height — 36" Diseases — Light Stagnospora	Aggressive bearded white wheat may have applicability in MRI systems. Sprouting seems not a significant problem as with other white wheats. May be sensitive to 2,4-D amine herbicide. Was only wheat damaged by herbicide application at Feeke's Growth Stage 5 in 1998.
Pioneer 2737W	Height - 37" Diseases — Light Stagnospora	This white wheat has performed well in Crawford County over the last two years; however, it may be discontinued in future.

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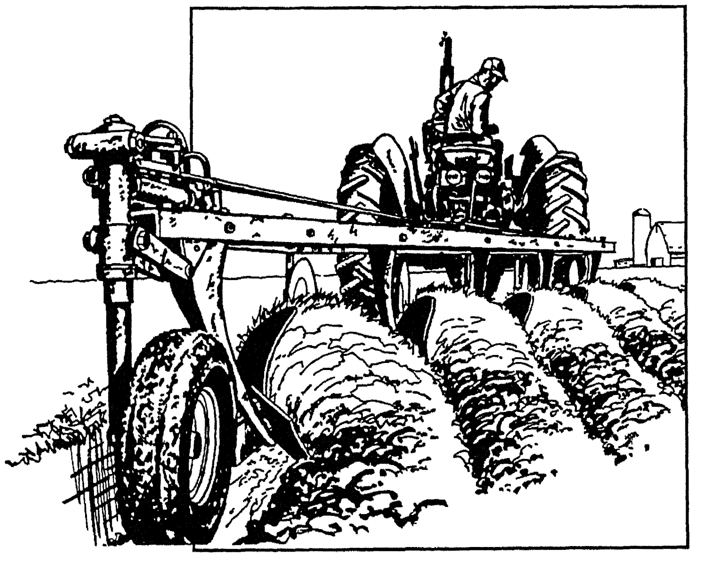
Tillage



Fall Strip Tillage and Fall Fertilizer for Corn

Jim Hoorman, Extension Agriculture/Natural Resources Agent
Dave Lotz, Hardin County Producer
Phil Rzewnicki, On-Farm Research Coordinator

Objectives

To compare yields and stand counts for corn receiving strip tillage and no tillage as well as to investigate fertilizer placement programs for strip tillage.

Nearest Town:	Kenton	Fertilizer:	10 gal. 28% N and
Previous Crop:	Soybeans		5 gal. 10-34-0 at planting
Soil Test:	pH 6.7		40 gal. 28% N sidedress
	P 31 ppm	Herbicide:	0.5 pt 2,4-D
	K 205 ppm		& 0.75 lb. Princep
	OM 3.3%	Planting Date:	May 14
	CEC 13.9	Emergence Date:	May 21
Variety:	Midwest 7667	Harvest Date:	October 27

Methods

Experiment design was a randomized complete block design with three replications of each treatment. Strip tillage was performed in late November of 1997. Broadcast and deep placement (8" deep in zone) of 150# 0-46-0 and 200# 0-0-60 was applied to the two strip till tr eatments in the fall. Individual strip plots were 24 rows in width and varied in length from 750' to 950' in length.

Results

	Emerged Population (plants/acre)	Harvest Population (plants/acre)	Yield (bushels/acre)
No-till/No pre-fertilizer	27,000 A	26,333 A	134.3 A
Strip till/No pre-fertilizer	31,667 A	32,667 B	147.5 A
Strip till/Broadcast fertilizer	29,833 A	27,667 A	138.4 A
Strip till/Deep fertilizer	30,000 A	28,000 A	140.4 A
F-statistic	2.00	4.68	1.20
CV (%)	8.0	7.7	6.2

Treatment means followed by same letter are not significantly different from each other at $P = 0.05$

Summary and Notes

Overall, strip tillage plots yielded 7.8 bushels/acre more than the no-till plots. However, no statistically significant differences among yields were found at the 5% and 10% levels of probability. When a contrast comparison is made between the strip-till treatments as a group (average = 142.1 bushels/acre) and the no-till treatment, the F-statistic is 1.80 with the probability of a greater F being 23%. This means the odds are about 3:1 that there is a real difference between strip till yields and the no-till yield which is not due to chance variation.

Averages of emerged and harvest populations among the four treatments were not significantly different from each other at the 5% level of significance. However, at the 10% level of significance (10% probability differences are due to chance alone), there are significant differences among the harvest population means. Pairwise comparisons indicate harvest plant population for strip-till/no pre-fertilizer was significantly higher than all other treatments.

However, the population comparison of more interest is the contrast between strip till populations as a group versus the no-till treatment. The emerged and harvest populations of the strip till treatments as a group (average 30,500 emerged and 29,444 harvested) were significantly different from the no-till treatment (27,000 emerged and 26,333 harvested) at the 10% level of probability.

With relatively high phosphorous and potassium soil test levels, no yield advantage was shown with the extra pre-fertilizer applied either broadcast or deep placement in the strip tillage plots in the fall.

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Soybean Residue: Tillage System Impact on Planting-Time Soil Conditions and Corn Yield

Alan Sundermeier, Extension Agriculture and Natural Resources Agent

Objective

Determine differences in planting time soil conditions in three tillage systems for corn planted into soybean residue and their impact on corn yield.

Site:	OARDC Hoytville Research Farm	Previous Crop:	Soybean
		Seeding Rate:	28,000/acre
County:	Wood	Planting Date:	May 19, 1998
Soil Type:	Hoytville clay		

Methods

In November 1997 plowing and strip tillage were completed. Hourly soil temperature (2-inch depth in seed zone) was recorded on all plots from April 25, 1998, until May 17, 1998. Growing Degree Days (GDD) from 4/25/98 to 5/17/98 were calculated and totaled. On May 18, secondary tillage was performed on the plowed plots while strip tillage and no-till were undisturbed as planting occurred. Soil moisture was determined from two-inch deep soil samples collected one week and again at one day before planting. The wet vs. dry weight was converted to percent water. Soil temperature was recorded on May 26, 1998, under full sun at 3 p.m. at two-inch depth or the seed zone with an air temperature of 80°F and corn at one-inch height. All data represent a minimum of three replications.

Results

	Growing Degree Days 4/25-5/17	5/13/98 Soil Moisture (% water)	5/18/98 Soil Moisture (% water)	5/26/98 Soil Temperature (°F)	Emerged Population (plants/acre)	Corn Yield (bu/acre)
Fall Plow	294.3 A	18.3 A	16.7 A	80.0 A	28,250 A	210.1 A
Fall Strip Till	289.5 A	17.6 A	16.0 A	78.6 A	29,000 A	212.9 A
No-Till	267.0 A	23.1 B	20.7 B	76.1 B	28,250 A	215.3 A
LSD (0.05)	42.8	3.38	3.16	1.52	1,605	9.84

Treatment averages followed by the same letter are not significantly different from each other.

Summary and Notes

No-till soil temperature on May 26 was significantly cooler compared to plowing and strip tillage soil temperatures. However, total Growing Degree Days (GDD) were not significantly different for all three tillage systems. One may conclude that tillage had a significant effect on soil temperature.

Soil moisture was significantly higher under no-till. Tillage allowed the soil to dry better.

Corn population and yields were not effected by type of tillage.

From this one-year study, one may conclude that when planting corn into soybean residue, planting-time soil temperature did not influence corn yield. However, due to rain on May 3, planting was delayed until May 18. Soil temperatures were already high (more than 80 degrees), and the benefit of soil warming from various tillage systems may have not been expressed. This experiment will be repeated next year in order to achieve earlier planting into cool soil.

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Wheat Residue: Tillage System Impact on Planting-Time Soil Conditions and Corn Yield

Alan Sundermeier, Extension Agriculture and Natural Resources Agent

Objective

Determine differences in planting time soil conditions in various tillage systems for corn planted into wheat residue.

Site:	OARDC Hoytville Research Farm	Previous Crop:	Wheat
		Seeding Rate:	28,000/acre
County:	Wood	Planting Date:	May 19, 1998
Soil Type:	Hoytville clay		

Methods

After wheat harvest, stubble was mowed. In November 1997, 90′ long plots were chisel plowed or strip tilled. In May 1998, half of the chisel plow plots were further tilled with field cultivator and finishing tool for optimum planting conditions. The remaining chisel plow plots were undisturbed (stale seedbed). On April 24, 1998, row sweeping was done in four plots to remove wheat residue from the corn row area without moving soil. On May 18, 1998, another four plots received row sweeping immediately before corn planting. Four plots remained as no-till.

Hourly soil temperature (two-inch depth in seed zone) was recorded on all plots from April 25, 1998, until May 17. Growing Degree Days (GDD) were calculated based on the soil temperatures. GDD for soil temperature under sod was also used for comparison as this is the soil temperature recorded for the branch experiment station.

Soil moisture data came from collecting two-inch deep soil samples in seed zones and drying. The May 26, 1998, soil temperature was recorded under full sun at 3 p.m. at two-inch depth (seed zone) with an air temperature of 80°F and corn at one-inch height.

Results

	Growing Degree Days 4/25-5/17	Soil Moisture (% water)	5/26/98 Soil Temperature (°F)	Emerged Population (plants/acre)	Corn Yield (bu/acre)
No-Till	241.3 A	19.8 A	72.5 A	26,500 AB	174.2 A
Sod	264.8 B				
April Sweep	267.5 B	18.3 A	76.3 ABC	26,250 AB	182.4 A
May Sweep			74.4 AB	24,250 AB	166.8 A
Strip Till	274.2 BC	17.7 A	77.5 BC	24,000 A	170.6 A
Chisel/Till	289.6 C		74.5 ABC	26,250 AB	182.6 A
Chisel Stale		19.3 A	79.3 C	27,750 B	182.4 A
LSD (0.05)	18.6	3.06	3.85	3,544	17.2
CV (%)	3.7	8.2	3.4	9.1	6.5

Treatment averages followed by the same letter are not significantly different from each other. All data represents a minimum of 3 replications.

Summary and Notes

No-till soil temperature was significantly cooler compared to any other tillage system, according to Growing Degree Days (GDD) data. However, May 26 soil temperature in no-till was only significantly cooler than the strip till and chisel stale seed bed treatments. One may conclude that fall tillage is necessary in wheat stubble to improve soil warming for corn next year as compared to no-till or row sweeping in the spring.

Soil moisture was not significantly different among the tillage systems compared for moisture.

Strip till had the lowest corn population, with chisel stale seed bed being significantly higher compared to strip till. Populations in all other tillage systems were not significantly different from no-till.

Although corn yields varied, yields among all tillage systems were not significantly different.

From this one-year study, one may conclude that when planting corn into wheat residue, planting time soil temperature did not influence corn yield. However, due to rain on May 3, planting was delayed until May 18. Soil temperatures were already high (more than 80 degrees), and the benefit of soil warming from various tillage systems may have not been expressed. This experiment will be repeated next year in order to achieve earlier planting into cool soil.

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Chisel Vs. No-Till Soybeans Following Corn

Dennis Baker, Extension Agriculture and Natural Resources Agent

Objective

The objective of this trial was to determine the effect of tillage on soybean yields when following corn in a field with a four-year no-till history.

Cooperator:	Darke County Farm	Fertilizer:	100#/A 0-46-0 broadcast
Nearest Town:	Greenville		125 #/A 0-0-60 broadcast
Major Soil Type:	Miami	Herbicides:	1.5 pt. Roundup pre-emerge
Drainage:	Tile		3 oz. Firstrate pre-emerge
Previous Crop:	Corn		1.5 pt. Roundup post-emerge
Soil Test:	pH 6.8	Planting Rate:	175,000 seeds/A
	P 51 ppm		30 inch rows
	K 149 ppm	Hybrid:	Countrymark 3975

Methods

A replicated study using five replicates in a randomized complete block design was planned to determine whether tillage affected soybean yields when following corn. Individual strip plots were 15' x 1,465' in size. The field had been in a no-till corn and soybean rotation for at least the past four years. The tilled plots were prepared using a chisel plow and disk unit followed by two passes with a conventional disk. Countrymark 3975 was planted on May 16 into adequate moisture.

Results

Treatment	Avg. Yield (Bu/A)
No-till	47.05
Chisel	47.65

F = 1.6 No significant difference among treatment means at $P = 0.05$, CV = 1.6%, LSD = 1.3 bu/A.
No significant difference among treatment means at $P = 0.20$, LSD = 0.7 bu/A

Summary and Notes

Emergence was uniform in all plots and soybeans looked very good all summer. There was no significant yield increase when using tillage on this particular site when planting soybeans after corn in a field with a four-year no-till history.

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Chisel vs. No-Till Corn Following Soybeans

Dennis Baker, Extension Agriculture and Natural Resources Agent

Objective

The objective of this trial was to determine the effect of tillage on corn yields when following soybeans in a rotation. Farmers in the area have suspected yield decreases due to tillage.

Cooperator:	Darke County Farm	Fertilizer:	75#/A 0-0-60 broadcast
Nearest Town:	Greenville		125#/A 18-46-0 broadcast
Major Soil Type:	Miami		150#/A N with herbicide
Drainage:	Tile	Herbicides:	5 qt. Extrazine
Previous Crop:	Soybeans		1/4 pt. Banvel
Soil test:	pH 6.4	Hybrid:	Pioneer 34G81
	P 34 ppm	Planting Rate:	30,000 seeds/A
	K 164 ppm		

Methods

A replicated study using six replicates in a randomized complete block design was planned to determine whether tillage affected corn yields when following soybeans. Individual strip plots averaged 30' x 1,045' in size. The field had been in a no-till corn and soybean rotation for the past four years. The tilled plots were prepared using a chisel plow and disk unit followed by two passes with a conventional disk. Pioneer 34G81 was planted on May 15 into adequate moisture and with adequate rainfall to activate herbicide and move nitrogen into the soil.

Results

Treatment	Avg. Yield (Bu/A)
No-till	106.10
Chisel	138.18

F = 124.5 Very significant differences among treatment means at $P = 0.01$, CV = 4.1%
LSD (0.05) = 11.6 bushels/acre

Summary and Notes

Emergence was uniform in all plots but as the corn grew, there became a very visible difference in corn height with the no-till being as much as 18 inches shorter. There was a significant yield increase when using tillage on this particular site when planting corn after soybeans.

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Soil Fertility

Deep Placement Compared to Broadcast P & K on Corn

Jeff McCutcheon, Extension Agriculture and Natural Resources Agent
Keith Dennis, Perry County Producer
Phil Rzewnicki, On-Farm Research Coordinator

Objective

To compare the effects of three different fertilizer programs on corn yields.

Nearest Town:	Rushville	Soil Test:	pH 6.5
Major Soil Type:	Centerberg & Luray		P 23 ppm
Drainage:	Improved		K 114 ppm
Tillage:	Minimum Till	Variety:	Consultants 1170
Previous Crop:	Soybeans	Planting Rate:	27,000/acre
Herbicide:	2.4 qt/acre Bicep	Planting Date:	April 25, 1998
Insecticide:	4.4 lb/acre Force		

Methods

A study was designed to compare corn yields under three different phosphorus and potassium fertilizer programs. Plots were field length (>750 ft.) and 54 ft. wide, replicated six times, and completely randomized. Anhydrous ammonia was applied at a rate of 190 lb./acre actual nitrogen in all plots. One fertilizer program was 18-46-60 actual applied per acre by broadcasting. The second fertilizer program was 18-46-60 actual per acre applied with the anhydrous and placed about eight inches deep in the soil. The third program was a half rate or 9-23-30 actual per acre applied with the anhydrous and placed at the same depth as the second. All fertilizer applications were made on the same date, April 11, 1998.

Results

Treatment	Harvest Population (plants/acre)	Yield[1] (bushels/acre)	Treatment Costs[2] ($/acre)
Broadcast Full Rate	15,996	156.1	18.87
Full Rate Deep Placement	14,893	158.8	20.69
Half Rate Deep Placement	15,728	155.9	11.44
	NS[3]	NS[4]	

[1] @15% moisture.
[2] Includes actual fertilizer cost, plus estimated machinery and fuel cost based on Ohio Farm Machinery Economic Cost Estimates for 1998.
[3] $F = 1.37$ No significant differences among population means at $P = 0.05$, CV= 7.8%
[4] $F = 0.43$ No significant differences among yields at $P = 0.05$, CV= 3.8%

Summary and Notes

Due to heavy rains after planting and the soil crusting it created, stand emergence was poor and variable. We plan to repeat this experiment next year with the hope of obtaining normal stands.

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Acknowledgement

This project was funded in part by a grant from the Innovative Farmers of Ohio.

Row Starter Compared to Broadcast Fertilizer on Corn

Dennis Baker, Extension Agriculture and Natural Resources Agent

Objective

To determine whether yields will be affected when fertilizer that is normally put on corn in the row is broadcast instead.

Site:	Darke County Farm	Fertilizer:	200#/A 7-34-20 in row plots
Nearest Town:	Greenville		125 #/A 0 -46-0 broadcast
Major Soil Type:	Miami		100#/A 0-0-60 broadcast
Drainage:	Tile		150#/A N sidedressed as 28%
Tillage:	No-till	Herbicides:	5 qt. Extrazine
Previous Crop:	Wheat		1/4 pt. Banvel
Soil Test:	pH 6.6	Planting Rate:	30,000 seeds/A
	P 28 ppm	Hybrid:	Pioneer 33G26
	K 142 ppm		

Methods

A replicated study using five replicates in a randomized complete block design was planned. The field had been in a no-till corn, soybean, and wheat rotation for several years. The corn was planted on May 18 into adequate moisture and with adequate rainfall to activate herbicide and move nitrogen into the soil. A Buffalo planter set up for slot planting was used. Fertilizer that was broadcast was spread just prior to planting. Emergence was uniform in all plots. Nitrogen was sidedressed on all plots as 28% when the corn was about 18 inches tall.

Results

Treatment	Avg. Yield (Bu/A)
Row Starter	105.45
Broadcast Fertilizer	109.61

F = 1.14 No significant difference among treatment means at $P = 0.05$, LSD = 10.8 bu/A, CV = 5.7%
No significant difference among treatment means at $P = 0.20$, LSD = 6.0 bu/A,

Summary and Notes

There was no significant yield increase when using row fertilizer in this particular trial. The low yields in all plots may have been due to dry weather in late July and August. Some producers have also had problems with lower corn yields following wheat with no tillage. Reasons may be soil moisture loss from a wicking effect of wheat straw or a toxicity effect of wheat straw decomposition.

The fertilizer openers on the Buffalo planter do not get the starter fertilizer down to two inches beside and two inches below the seed as recommended for good fertilizer placement.

This planter places fertilizer about one inch below the surface and one inch to the side of seed drop. This trial will be repeated in future years.

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Effect of Liming with Different Ca/Mg Content

Alan Sundermeier, Extension Agriculture and Natural Resources Agent
Rich Bennett, Henry County Producer

Objective

Compare two different lime sources for their effect on soil test values and crop yields.

Nearest Town:	Napoleon	Drainage:	Tile
Soil type:	Millgrove loam	Crops:	1995 - wheat 1996 - corn
Tillage:	Conventional		1997 - soybeans 1998 - corn

Methods

In the same field, two different types of lime were applied to separate 45-foot-wide field-length strips in a randomized, complete block design. From Bucyrus, Ohio, a high calcium (Hi Ca) lime (analysis: 33% Ca, 4% Mg, 99% total neutralizing power or TNP) was randomly applied to 6 strips. From Woodville, Ohio, a low calcium (Low Ca) lime (analysis: 23% Ca, 10% Mg, 107% TNP) was randomly applied to six strips.

Initial soil samples were taken in September 1995. In October 1995 two tons per acre of lime were applied according to plot design. In October 1996 corn yields were recorded for each strip and soil samples were taken. In November 1996 another two tons per acre of lime were applied according to plot design. In September 1997 soybean yields were recorded and soil samples were taken. In September 1998 corn yields were taken and soil samples were taken.

Results

Yields (bu/A)	1996 Corn	1997 Soybeans	1998 Corn
Low Ca	131.9	49.3	198.9
Hi Ca	128.9	50.6	201.2
LSD (P = 0.05)	6.3	1.6	5.3
CV (%)	3.3	1.8	1.5
Significant Difference	No	No	No

pH	9/95	10/96	9/97	9/98
Low Ca	5.57	5.43	6.07	6.12
Hi Ca	5.60	5.55	6.23	6.60
LSD (P = 0.05)	0.25	0.40	0.32	0.15
CV (%)	3.07	4.85	3.46	1.38
Significant Difference	No	No	No	Yes

Ca % base saturation	9/95	10/96	9/97	9/98
Low Ca	56.4	39.3	51.7	80.6
Hi Ca	57.7	46.8	61.7	62.0
LSD (P = 0.05)	4.08	14.5	12.0	5.01
CV (%)	4.82	22.7	14.2	4.0
Significant Difference	No	No	No	Yes
Mg % base saturation	**9/95**	**10/96**	**9/97**	**9/98**
Low Ca	16.5	11.0	16.0	24.6
Hi Ca	16.7	11.3	21.2	17.2
LSD (P = 0.05)	1.6	3.7	3.8	5.1
CV (%)	6.4	22.2	13.9	13.9
Significant Difference	No	No	Yes	Yes

Summary and Notes

The two different lime sources resulted in significantly different values for pH and Ca in the last year of this study and Mg in the last two years. However, an economic return for this lime was not realized since yields were not significantly different. The Hi Ca lime source cost was $4.50 per ton more than the low Ca lime source.

Initially in 1995, the test field had medium levels of soil calcium and high levels of magnesium; also the Ca/Mg ratio was over 3:1. Therefore, with a soil pH of 5.6 and a Ca/Mg ratio greater than 1:1, the farmer need only be concerned with raising the soil pH. The fineness of the lime and TNP (total neutralizing power) are the more important quality measures for comparing lime sources. As long as the soil Ca/Mg ratio is more that 1:1, the farmer need not worry about adding a concentrated Ca lime source. Raising soil pH is not necessarily related to the Ca and Mg content of the lime. Most northwest Ohio soils are not deficient in calcium.

A farmer should select the cheapest lime source that will neutralize the soil. The calcium and magnesium content of that lime is less important than TNP in most northwest Ohio soils. This study confirmed that yield was not affected by the type of lime applied.

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Effect of Variable Rate Phosphorus and Potassium Applications on Grid Soil Test Values

Steve Prochaska, Extension Agriculture/Natural Resources Agent

Objectives

Grid soil sampling (GSS) has recently been implemented by a number of area farmers in order to gather soil test information on small areas of their fields. The areas are geo-referenced so specific amounts of fertilizer or lime may be applied to these small areas. Geo-referenced grid information is also valuable for building geographic information systems (GIS) by overlaying yield maps, soil type maps, topography maps, etc.

GSS can also be used to examine variability of soil pH, phosphorus, and potassium. With their new experiences with GSS information, area producers have questions regarding previous soil test collection methods and the accompanying results. This study was undertaken to measure soil test level changes in pH, phosphorus, and potassium in a grid soil sampled field after a variable rate application of phosphorus and potassium and a single year of corn growth.

Location:	Ohio State University Unger Farm, Crawford County	Fertilizer:	Variably applied 4/23/97 - range 36-92-120 to 90-230-300
Soil Type:	Pewamo	Seeding Rate:	Variable (part of corn population study)
Drainage:	Systematic		
Tillage:	Field cultivate once	Planting Date:	5/7/98
Previous Crop:	Fallow	Harvest Date:	10/16/98

Methods

An area of the Unger farm where extensive tiling was to be done was grid soil sampled both in April 1997 and November 1998. Because smaller is considered to be better in regard to grid size, 0.33 acre was chosen as the standard grid size. Six grids were randomly selected from the total of 15 for comparative analysis. Soil samples were taken in the middle of the grid (four soil probes 8" deep around an all-terrain vehicle) for each test in 1997 and 1998.

Variable rate P and K were applied 4/23/97 using 18-46-0 and 0-0-60 and a corn yield goal of 200 bu/acre. Corn was planted and harvested in 1998. What appears on the next page is an analysis of the changes in soil pH, P, and K after variable rate applications of P and K and harvest of 200-bushel corn.

Results

Grid #	1997 pH	1998 pH	1997 P (ppm)	1998 P (ppm)	1997 K (ppm)	1998 K (ppm)
1	7.3	6.4	10.0	39.0	90.0	180.0
2	7.1	7.2	16.0	33.0	142.0	135.0
3	7.2	6.4	26.0	33.0	155.0	172.0
4	6.7	6.8	19.0	24.0	167.0	149.0
5	6.8	7.3	15.0	26.0	64.0	88.0
6	6.8	6.6	13.0	24.0	158.0	136.0
Average	**7.05**	**6.78**	**16.5**	**29.8**	**129.3**	**143.3**
	F = 2.01 NS CV = 4.7%		F = 15.7 Significant $P = 0.05$ CV = 25.2%		F = 0.41 NS CV = 27.7%	

Summary and Notes

Phosphorus and potassium used by a 200 bu/acre corn crop would be 74 lbs/acre P_2O_5 and 54 lbs/acre K_2O respectively. The base rate (lowest rate setting for variable rate applicator) was 200 lbs/acre 18-46-0 and 0-0-60. Thus, the net P_2O_5 and K_2O was at least 18 lbs/acre P_2O_5 and 66 lbs/acre K_2O. Phosphorus soil test levels went up in every sample grid. Potassium levels actually went down in three grids. Average phosphorus levels went up 13.3 ppm and average potassium levels rose 14.0 ppm. The second year soil P levels were significantly higher than the beginning P values. Variable rate application raised all sample grid P levels to critical soil test levels where little or no additional P fertilizer would be needed for a subsequent crop. Potassium soil-test levels were raised for the variable rate area; however, second-year levels were not significantly different from initial readings, and critical soil-test levels were not reached. Soil pH did not change significantly and it was not expected to do so.

In 1998 a variable rate application of P was captured by soil samples from grids while K soil samples revealed half the grids increasing in soil test value and the other half decreasing in soil test value.

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The Effect of Granulite Sludge on Nitrogen Rates for Corn

Alan Sundermeier, Extension Agriculture and Natural Resources Agent
Roland Rettig, Henry County Producer

Objective

Determine if the addition of Granulite Sludge makes a significant difference for increasing corn yields.

Nearest Town:	Napoleon	Drainage:	Tile
Soil type:	Millgrove loam	Starter fertilizer:	140 lbs/acre 19-17-0
Tillage:	Conventional	Previous Crop:	Wheat

Methods

Granulite sludge is a dried, pelletized source of organic nutrients with an analysis of at least 5-3-0. In the study areas, Granulite was applied during the fall of 1997 at the rate of 4,000 lbs/acre at a cost of $17 per ton.

Three fields with Granulite application were used for study. The Knepley field in 1997 was in wheat (no clover). Nitrogen sidedress rates of 80 lbs/acre vs. 110 lbs/acre were compared in four randomized, replicated field-length strips. The Fruth field was soybeans in 1997. Nitrogen sidedress rates of 145 lbs/acre vs. 175 lbs/acre were compared in four randomized, replicated field-length strips. The Long field was wheat in 1997 with a good stand of clover. A 100 x 30 foot area did not receive sidedress nitrogen to compare 0 vs. 150 lbs/acre. In this study area, four random soil nitrate samples were collected throughout the growing season.

Pre-Sidedress Nitrogen Test (PSNT) soil samples were taken (5-26-98) in all fields before sidedress nitrogen application. After maturity (9-29-98), corn stalk nitrate samples and soil nitrate samples were taken. Corn yields were recorded with a yield monitor.

Results

Knepley Field	Soil Nitrate	Soil Nitrate	Stalk Nitrate	Corn Yield
	5/26/98	9/29/98	9/29/98	bu/A
80 lb N	7.0 ppm	2.0 ppm	287.5 ppm	176.1
110 lb N	7.0 ppm	2.7 ppm	308.2 ppm	179.1
LSD (*P* = 0.05)	1.84 ppm	3.01 ppm	768.0 ppm	3.89
Significant Difference	No	No	No	No

Fruth Field	Soil Nitrate	Corn Yield
	5/26/98	bu/A
145 lb N	6.25 ppm	182.3
175 lb N	7.0 ppm	181.6
LSD (*P* = 0.05)	3.98 ppm	2.02
Significant Difference	No	No

Long Field	Soil Nitrate (ppm)									
	5/26	6/4	6/10	6/16	6/29	7/7	7/20	8/11	9/29	Stalk Nitrate (ppm)
No N	5.2	22.7	21.2	21.5	20.2	19.7	13.5	4.0	0.7	85
150 lb N							10.0	10.0	2.7	409
LSD (*P* = 0.05)									2.25	203
Sig. Difference									No	Yes

Summary and Notes

In this study, corn yields were not significantly different with different rates of sidedress nitrogen. Granulite sludge may have contributed extra nitrogen to allow the lower sidedress nitrogen to yield equally well in the Knepley and Fruth fields; however, a check strip with no Granulite was not available to confirm this. In both field sites, a reduction of 30 lbs/acre nitrogen did not significantly reduce yields.

The Knepley field showed lower than optimum levels of stalk nitrate (701 – 2,000 ppm optimal). Also, soil nitrate levels on 9/29/98 were very low. Although yields were nearly 180 bu/acre, these results indicate that the corn plant was deficient of nitrogen and higher yields may have resulted with additional nitrogen application. The economic return of adding extra nitrogen must also be considered.

The Long field indicates that with no additional nitrogen added, soil nitrate levels were nearly sufficient throughout the growing season (25 ppm soil nitrate adequate). Granulite added to the 1997 spring seeded clover crop may have contributed to this source of organic nitrogen. Corn stalk nitrate levels were significantly lower compared to fertilized corn plants; however, both were below optimum stalk nitrate levels.

The amount of release of usable nitrogen from Granulite sludge is difficult to predict. Organic sources may be slow to decompose and may not match crop needs. However, an organic source of nutrients can enhance soil quality and benefit plant growth.

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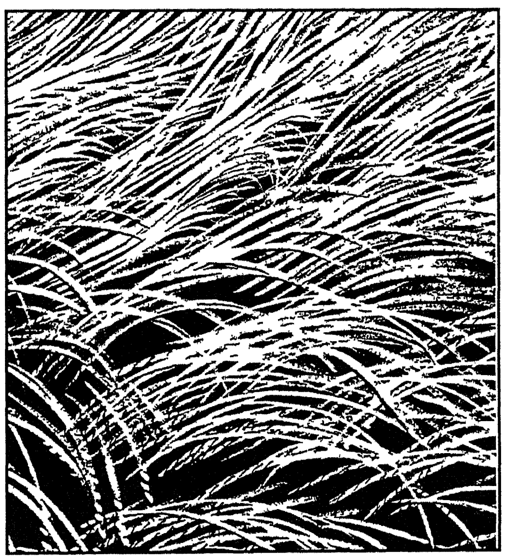
Cover Crops



Cover Crop Comparison

Alan Sundermeier, Extension Agriculture and Natural Resources Agent

Objective

To compare several annual cover crops following winter wheat and preceding corn. Cover crops to be evaluated by biomass accumulation, nitrogen contribution, and effect on no-till corn yield.

Site:	OARDC Hoytville Research Farm in Wood County
Soil type:	Hoytville clay
Previous Crop:	Wheat

Methods

Wheat stubble was mowed after harvest. On 8/7/97, cover crops were drilled no-till at the following rates: Flyer soybeans — 100 lbs/acre, oilseed radish — 10 lbs/acre, cowpea — 60 lbs/acre, Austrian winter pea — 60 lbs/acre. A check with no cover crop was included. Treatments were randomized and replicated three times. Biomass was measured 9/29/97 before killing frost by removing above ground cover crop growth in one square foot and drying the material at 180°F for 48 hours. On 6/17/98, pre-sidedress nitrate soil levels were measured. All inputs remained constant over treatments.

Results

Cover Crop	Biomass Accumulation (grams/sq.ft.)	Soil Nitrate (ppm)	Corn Yield (bu/acre)
Winter Pea	3.0 A	14.5 A	197.6 A
Soybeans	8.0 AB	20.0 BC	192.8 A
No Cover	—	21.0 B	185.8 A
CowPea	2.0 A	17.0 D	185.3 A
Oilseed Radish	18.7 B	18.0 CD	161.0 B
LSD (0.05)	12.06	2.15	17.9

Treatment means followed by the same letter are not significantly different at $P = 0.05$

Summary and Notes

Cover crops preceding corn planting did not significantly improve corn yields compared to no cover crop. Oilseed radish significantly reduced corn yields compared to the other cover crops. In this test, the cost of cover crops did not show an economic return since yields were not increased.

Biomass accumulation was greatest in oilseed radish, which would improve soil organic matter and compete well with weeds. Soybean biomass was also significantly better than cowpea or winter pea. Volunteer wheat was very competitive to cover crop growth and may have restricted performance.

Soil nitrate results did not show an advantage to cover crops. Due to no-till planting and natural winterkill of the cover crops, potential nitrate contributions were limited.

Flyer soybeans appear to be the best choice for a late summer seeded cover crop in this study. In all three measured areas (biomass, soil nitrate, and yield), soybean cover crop was significantly better. A precaution against using soybeans as a cover crop is the potential risk for disease and increased numbers of soybean cyst nematodes in infested fields.

Earlier planting of cover crops immediately after wheat harvest and control of volunteer wheat may improve the performance of late summer planted cover crops. The amount of nitrogen contribution from cover crops is difficult to predict and may not become available until after corn sidedress time (mid-June). Soil moisture and temperature greatly affect nitrogen release from an organic source. The soil quality benefits of cover crops were not measured.

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Appendix

A Word About Statistics

Why Statistics?

To assess the variability that is always present, and then make reasonable, mathematics-based guesses as to whether or not observed effects are due to chance or to treatments.

When we conclude that there is a reasonable chance that differences were in fact due to treatments, then we say treatments had a *significant effect*. This conclusion does not mean that we **proved** that the treatments caused differences, only that we are satisfied that our guess is probably correct.

When we are unable to draw the conclusion that treatments differed, we say that the treatments are *not significantly different*. This does **not** mean that treatments had no effect — it simply says that our research trial was not able to detect such an effect. There are two possibilities here — either the treatments really did not have an effect, or they did have an effect, but the experiment was not adequate to detect it.

Small effects are very difficult to prove. This is due to the fact that unexplained variation or "background noise" will usually "drown out" small effects. As a means to evaluate how well a particular trial was able to control unexplained variation, we use the Coefficient of Variation or CV. It is simply the standard deviation of all samples in a trial divided by the overall mean of all samples. It is usually expressed as a percentage of the overall mean. A goal for most field trials is to achieve a CV of 12% or less. The smaller the CV or "background noise" the easier it is to detect variation due to treatments. A trial having a CV of 5% and five to six replications of each treatment will have a reasonable chance of detecting a true 10% difference between treatment means.

What Does Probability Level Mean?

If we declare two averages are "significantly different" at 5% probability level or $P = 0.05$, we are saying that we are willing to make a mistake one out of 20 times if in fact they are truly equal. The 5% probability level is the standard used for most field trials. However, 5% may be too conservative or overly cautious for some farmer-researchers. In some on-farm research trials, it may be decided that a wrong decision may not be very costly. This could be the case where treatment costs are essentially the same, e.g., seed costs in variety comparisons. It may be decided to use a probability level of 10% if one is willing to make a mistake one out of 10 times, or 20% for a risk of one out of five.

Picking the probability level is a "decision rule." Increasing the sample size or replicates reduces the chances of making an incorrect decision when the same decision rule is applied.

In on-farm research trials, experience has shown that five to six replicates are usually needed to detect meaningful and real differences between treatments if they exist. Each treatment is represented at least once within each replicate. Replications may be located adjacent to each other within a single field or located in separate fields or farms.

Randomization of treatments within a replicate is important to avoid biased location of treatments. Having treatments in the same order in replicates across a field may cause bias due to soil fertility trends or soil moisture trends stretching across the field.

The F-Test and Least Significant Difference

A test for significance for differences between or among treatment means is the F-test. It is the ratio of the variation due to treatments divided by the variation of individual samples. Values close to one indicate there is little or no variation due to treatments. Values much larger than one indicate that variation due to treatments is larger than expected by chance alone.

If an F value for a trial is found to be significant and there are more than two treatments being analyzed, then further testing requires calculating another test for significance called the Least Significant Difference (LSD). The LSD helps to detect which pairs of treatment means are significantly different from each other. When a trial contains more than two treatments, it is sound statistical protocol to conduct an F-test before pairwise comparisons are made with an LSD. This procedure is referred to as *Fisher's (protected)* LSD. If a trial contains only two treatments, then using an F-test to find significance is equivalent to using LSD alone.

For most trials in this report, an F-statistic was calculated first. If treatments were found to be significantly different, then an LSD is usually reported in lieu of the F value.

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